1920

FIRST ANNUAL REPORT

1920

OF

THE ADVISORY COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH OF ALBERTA

PRINTED BY ORDER OF THE LEGISLATIVE ASSEMBLY

EDMONTON:
PRINTED BY J. W. JEFFERY, KING'S PRINTER
1921

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EDMONTON, ALBERTA,
FEBRUARY 18, 1921.

HON. J. L. COTÉ,
Provincial Secretary,
Edmonton, Alberta

SIR:—I herewith submit the First Annual Report of the work done under the direction of the Advisory Council of Scientific and Industrial Research of Alberta, for the year ending December 31, 1920.

The Scientific and Industrial Research Council of Alberta was formed on January 6, 1921, by Order in Council, a copy of which is herewith attached:

"The Executive Council has had under consideration the report of the Honourable the Provincial Secretary, dated December 30th, 1920, stating that:

" 'Whereas about two years ago the Government decided to institute Provincial research work with a view to ascertaining more definitely the mineral resources of the country and the possibilities of their development, and for the furtherance of such purposes an amount was set apart to meet the necessary expenses involved; and

" 'Whereas a preliminary survey has been made with most encouraging results; and

" 'Whereas the work has been carried on, and can best be continued, in co-operation with the University of Alberta; and

" 'Whereas it has been found expedient to engage experts from the University teaching staff with specialized knowledge and technical skill, in order to obtain exhaustive analyses and full reports; and

" 'Whereas it has been decided to have the work continued along the lines indicated; and

" 'Whereas it is deemed desirable to appoint a council of five members, without remuneration, to supervise and direct future work, and to arrange for the necessary staff, and to define the duties of each member, with power to enter into an agreement or agreements with the University of Alberta for the assignment of specialists to the various classes of research work to be followed; and for the time, materials, laboratory equipment, and other accommodation required;'

"Therefore, upon the recommendation of the Honourable the Provincial Secretary, the Executive Council advises that a council of five members, to be known as 'The Scientific and Industrial Research Council of Alberta,' be and is hereby appointed, without remuneration, to supervise and direct research work, to engage specialists to perform such work, and to define the duties of each, and that such council be and is hereby authorized and empowered to enter into an agreement or agreements, subject to the approval of the Lieutenant-Governor-in-Council, with the University of Alberta for the services of members of the University staff to prosecute the various classes of research work decided upon by the council, and for the time, materials, laboratory, and other accommodation required for the efficient performance of such work; the members of the said council to be: Hon. J. L. Coté (Chairman), Dr. H. M. Tory, Professor John A. Allan, Professor N. C. Pitcher, and John T. Stirling, Chief Inspector of Mines."

This report contains the report of Professor N. C. Pitcher, entitled "Screening and Storage of Coal"; reports of "Analyses of

Coal," by Mr. J. A. Kelso; report of Professor John A. Allan, entitled "Salt Explorations at Fort McMurray"; and report of Dr. K. A. Clark, entitled "Programme of Work to be Undertaken in the Study of Alberta Road Materials and Problems Arising from them."

In addition to this, Dr. Allan conducted a considerable amount of geological field-work.

Attention was given to the occurrences and character of the bituminous sands exposed along the Athabaska river for a hundred miles below McMurray. Samples from special localities were collected and treated in the Research Department of the University of Alberta. The salt-spring deposits on the northern boundary of the province, west of Fort Fitzgerald, were also examined and reported upon.

Preliminary examinations were made of undeveloped coal basins on the Highwood and Sheep rivers, and a preliminary study was made of the geological structure along the Coal Branch between Coalspur and Lovett. The reconnaissance work carried on in both of these areas has proven conclusively how incomplete and inadequate the information is which we have on our coal resources.

Research work both in the field and laboratory on certain bentonite clays and ochres within the province, have shown that both classes of material occur as economic deposits in Alberta. In the Research Department, Dr. K. A. Clark has demonstrated many uses for the bentonite clay, which is better known as gumbo clay, so that material which has been previously regarded as of no value, and as a detriment to agriculture and road-making activities, may prove to be an asset to the province.

Considerable time was also spent on investigating reported occurrences of iron and other minerals.

All the work referred to in this report has been done at the University of Alberta.

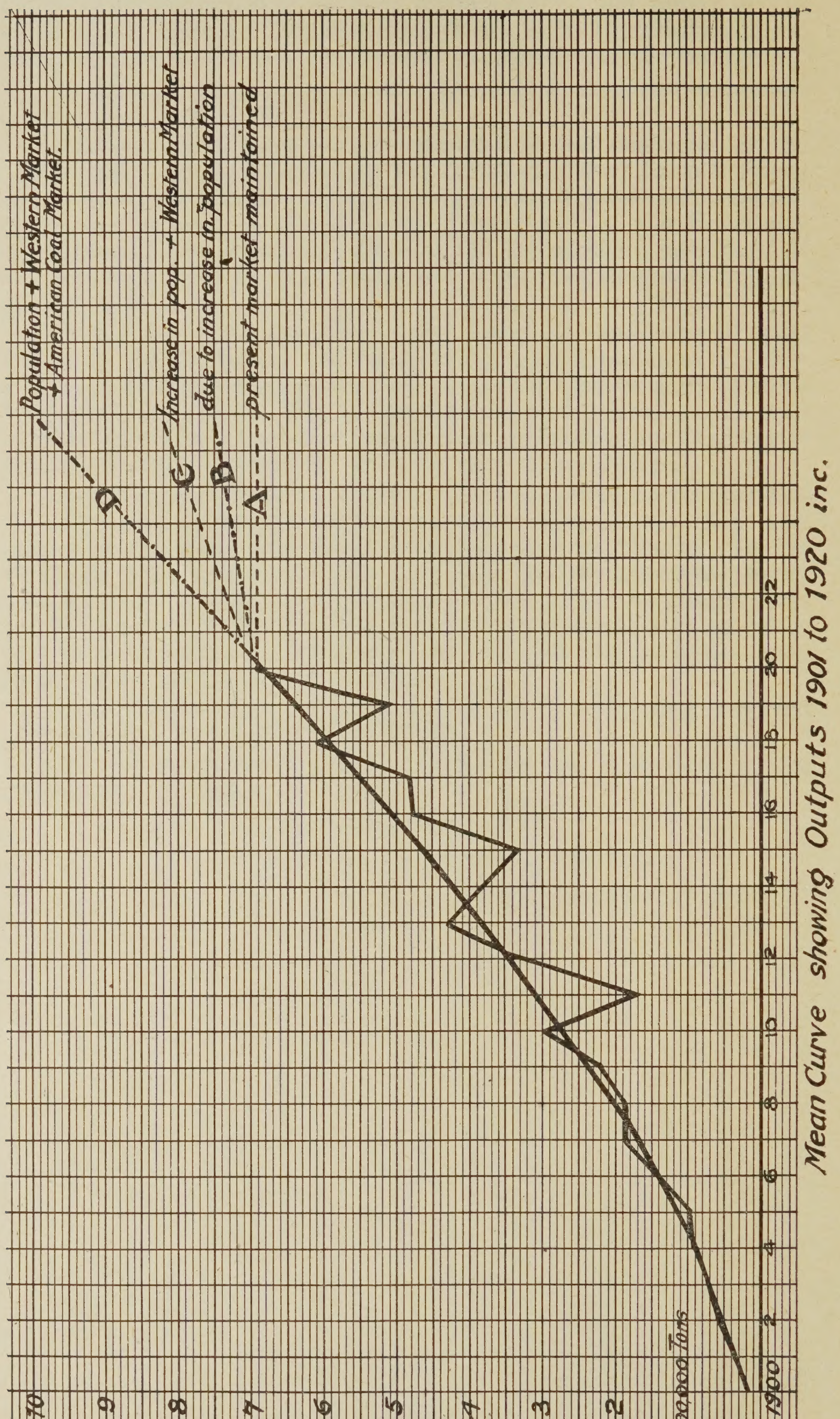
Yours truly,

JOHN T. STIRLING,

Chief Inspector of Mines.

SCREENING AND STORAGE OF COAL

By Professor N. C. Pitcher



THE DIAGRAM on the opposite page is a mean curve showing the outputs of coal of the Province of Alberta from the year 1901 to 1920, though for the years 1901 to 1905 the outputs given include the Province of Saskatchewan.

The output curve has been projected up in its natural curve till the year 1927 (D).

The report of the Chief Inspector of Mines goes fully into the causes of the widening eastward of the market for Alberta coal, and it is to be expected that this eastward extension will not be materially advanced in the next decade, if indeed Alberta, under the conditions of the keen competition of American coals, can maintain this market.

Under normal conditions we may expect an increase in population in this market of perhaps 20,000 people annually, which will afford an additional 50,000 tons annual demand. This will bring up the probable mean curve to that shown as (B).

The Alberta Trade Commissioner is investigating the possibilities of a larger market to the west, and especially the northwest, along the Canadian National Railway the results of which survey, if as successful as hoped, may bring the curve as shown in (C), but it is realized that the greatest gain in market is to be obtained by replacing the present imports of American coals from somewhat east of Winnipeg west; should this be accomplished, the curve would then follow that shown as (D).

We have in mind and in hand a long series of experiments, the outcome of which, it is hoped, will demonstrate many ways of improving the preparation and use of these coals, which will enable the Alberta product to largely replace imported coals in the territory mentioned; and we have laid out a tentative programme of experiments (see detailed list below) on storage, screening, cleaning, furnace operation and design, pulverizing, carbonizing, briquetting colloidal coal, etc.

It is realized that under the present methods of storage a large number of the Alberta coals disintegrate if stored for a considerable time. This disintegration forms slack, and renders the larger lumps tender, but it is expected that, after an extensive study of their physical and structural properties, a practical method of storage will be evolved which will materially reduce this tendency.

Special studies are required as to burning qualities under both steam and domestic furnaces, and it may be that new designs of both grate and combustion chambers can be evolved which will greatly improve the efficiency in burning these coals.

Having in mind the existing confusion amongst dealers and customers in the knowledge of sizes and qualities of the different coals offered by the operators of this province, we would recommend that some classification of the different coals be made both as to quality and sizes ordinarily offered for sale.

In conjunction with the Mines Branch we have drawn up a proposed uniform method of sampling coal in the mine and car load lots, by which results will be obtained which will be more representative of the average analysis of the coal produced than was obtained by the methods used heretofore.

PROGRAMME OF SCREENING AND STORAGE TESTS

1. Chemical analysis of all coal as received made including B.T.U.

2. Equivalency of perforated and bar screens on coals from different fields, using the following perforations as standard:—

	Through.	Over.
Lump	....	3 in. perforations
Stove or egg	3 in. perforations	1½ in. perforations
Nut	1½ in. perforations	¾ in. perforations
Pea	¾ in. perforations	¼ in. perforations
Dust	¼ in. perforations	....

Slack all through ¾ in. perforations.
Nut slack all through 1½ in. perforations.

3. The above to be run on run of mine from the various districts, and at the same time a record kept which will show the percentage of each of the above in the different samples of run of mine coal.

4. Coals as received. Ash analysis to be made of each size.

5. While doing the above screening, a test will be run on the different sizes to determine the amount of breakage made in the handling of coal; that is, after having determined the proportions of lump, egg, etc., in a certain kind of run of mine. These different grades should be re-screened separately. The results obtained will show what breakage the coal undergoes in being handled over the screens.

6. Having separated the coal into different sizes, samples of run of mine, lump, egg, and nut pea should be set aside for testing each in open storage, shed storage and pit storage.

Use Run of Mine	1 ton
Lump	½ ton
Egg	½ ton
Pea	½ ton
Nut	½ ton
Screened	1 ton (lump and egg)

The above samples are to be screened and re-analyzed, at the end of one month, six months, one year and two years, to determine slacking losses in size and change in chemical composition, as well as heat value.

Bituminous coals run of mine only stored in open storage and chemical analysis taken at end of first month, six months, one year and two years.

7. Evaporation tests under Babcock & Wilcox Boilers, both hand and stoker fired, on different sizes of coal.

PROGRAMME FOR FUEL TESTING AND RESEARCH

1. Exact determination of products and by-products obtained by carbonization of Alberta coals under varying conditions of final temperature, rate of heating, pressure, etc. A special apparatus for rapid testing of small samples to be constructed and employed.

2. Carbonization tests of non-coking lignites in continuous inclined retorts. Small retort to be built, capable of handling about 20 lbs. of coal per hour.

3. Study of the gas-producing qualities of Alberta coals on a semi-commercial scale. If, as has been suggested, a bench of gas retorts be installed to supply the University with gas, one retort could be provided with separate gas offtake and purifying apparatus to allow these tests to be made.

4. Standardization of a method for the air-drying of coal, and collection of data with regard to moisture holding properties of Alberta coals.

5. Colloidal coal—preparation and properties of "colloidal" fuel made from raw, dried and carbonized fuels.

6. Powdered coal—suitability of different coals, either in the raw or treated condition, for use as powdered fuel.

7. Complete and exact analyses of all solid, liquid, and gaseous fuels occurring in the province.

8. Determination of empirical formulæ for the valuation of coals from each field by means of proximate analyses.

9. Briquetting tests on raw, dried, and carbonized coals.

10. House-heating furnaces and heat distribution through houses.

11. Study of coking qualities of and methods of coking most suited to Alberta coals.

12. Producer gas generators.

13. Water gas plants.

SCREENING AND STORAGE TESTS UP TO DEC. 31, 1920

Some mines use grizzly or bar screens and others perforated screens; no data are available as to the equivalency of the two. Work is being done to get a standard equivalency for these different styles of screens, and some suggestions in this regard are embodied in this report.

Technical Staff

The coal screening storage and equivalency tests are being carried out by Mr. R. T. Hollies, B.Sc., assisted by Mr. T. Holmes in the Mining Engineering building.

The chemical analyses, including the heat values of the coals, are being done by Mr. R. T. Hollies, B Sc., under the supervision of Mr. J. A. Kelso, M.Sc., Director of the Provincial Industrial Laboratories.

The Boiler trials are conducted by Professor C. A. Robb, M.Sc., Professor of Mechanical Engineering, assisted by Mr. McMillan, Chief Engineer, University Power Plant, and Mr. R. T. Hollies, B.Sc.

Professor N. C. Pitcher, B.Sc., Professor of Mining Engineering (University of Alberta), has supervision of all investigations.

LABORATORIES

(a) The screening is done on a Marcus screen purchased from Donkin and Stevens of Edmonton, and placed in the University Mining Laboratory. Difficulty in getting the machinery ready in the fall of 1920 prevented as early a start as was planned. It was not until November 8 that the first part of a car-load of coal was received. When this lot was disposed of, difficulty was again encountered in getting the next lot of coal, due to local labor trouble tying up the mines from which the coal had been promised. This second lot was not received until December 15. The report of 1920 is on tests on these two samples.

(b) The chemical analyses are all being made in the Provincial Industrial Laboratories, as noted above.

(c) The boiler trials are being conducted at the University Power Plant No. 2, both in hand-fed and stoker-fed Babcock and Wilcox boilers, using chain grate stokers of the close link type.

(d) Storage:—

1. Open storage where coal is dumped on the ground. Capacity—shed or pit storage.
2. Shed storage was provided for by special shed built near the University Power Plant No. 2. Capacity—18 lots of one ton each.
3. Pits for storage near the sheds were dug and covered in. Capacity—15 lots of one ton each.

DESCRIPTION OF STORAGE FACILITIES

Each size of each sample of coal is stored in half-ton and one-ton lots in the open, in pits and in sheds respectively. The following is a rough description of the storage facilities:

1. *Open Storage*

Adjacent to, and west of, the storage shed described below, an area 40 feet square has been cleared of poplar and underbrush on the ground for half-ton and one-ton lots of the different sizes of the different samples, no precautions being taken to insure drainage, to protect the stored coal from the weather or to prevent the coal being mixed with dirt when removed for sampling and testing after storage. Total capacity—shed storage.

2. *Pit Storage*

Adjacent to, and east of, the storage shed are the storage pits. Each is 20 feet long, and 5 ft. 6 in. wide at the top, 4 ft. wide at the bottom, and 3 ft. deep. They are lined with poplar poles, and divided into compartments 5 ft. 6 in. by 6 ft. at the top, 4 ft. by 6 ft. at the bottom, and 3 ft. deep. These pits are of ample size to store one-ton samples. The bottom is of clay levelled and tamped hard, and affords a clean surface on which to dump the coal. The pits are well covered by tightly fitting one-inch shiplap lids to keep out the rain and snow, and if necessary these can be covered by sods to maintain an even temperature in the pits. Capacity—15 tons.

3. *Shed Storage*

The shed is built of 2 in. by 4 in. studding and 1 in. shiplap, with a tight roof. It is 25 ft. long, 9 ft. wide, and 8 ft. high, with a shanty roof; but has no floor. The shed is divided into six bins, 4 ft. by 9 ft., and each of these can be further divided into three compartments, 4 ft. by 3 ft., capable of storing one-ton samples. Each bin has 2 ft. by 8 ft. opening, which can be boarded up as filled. The shed is not completely weather-tight, but is capable of keeping out rain and snow, and direct sunlight. Storage capacity—18-ton lots.

SCREENING TESTS

Note:

R. Coal as received analyses calculated from sample.

A.D. Air-dried sample on which all analyses was carried out.

B.T.U. British Thermal Unit defined as other quantity of heat required to raise one pound of water one degree Fahrenheit (62 to 63).

CADOMIN COAL

Locality ....Layland, G.T.P. Local Branch.
Kind of Coal ....Bituminous Steam Coal.
Date received ....November 8, 1920.

Condition of Moisture.	As received.		After one month open storage.	
	R.	A.D.	R.	A.D.
Loss on air drying	2.2	.....	3.3	.....
Moisture	3.7	1.5	4.3	1.0
Volatile matter	25.4	26.0	25.1	26.0
Ash	10.4	10.6	12.0	12.4
Fixed carbon	60.5	61.9	58.6	60.6
Calories	7377	7541	7095	7333
B.T.U. per pound	13280	13570	12770	13200

EQUIVALENCY TESTS

	Standard perforated screens.		Bar screens equivalent.	
	Through.	Over.	Through.	Over.
Lump	..	3 in.	..	2 in.
Stove or egg	3 in.	1½ in.	2 in.	¾ in.
Nut	1½ in.	¾ in.	¾ in.	½ in.
Pea	¾ in.	¼ in.	½ in.	Less than ¼
Dust	¼ in.	..	Less than ¼ in.	..
Slack	¾ in.	..	½ in.	..
Nut slack	1½ in.	..	¾ in.	..

From the table above it is seen equivalencies were found for all sizes, except pea and dust. From the screening data the following bar screen would give practically the same percentage of pea and dust in Cadomin coal as the standard perforated screens.

STANDARD SIZES IN RUN OF MINE

Size.	Standard Perforated.		Bar Screen.	
	Through.	Over.	Through.	Over.
Pea	¾ in.	¼ in.	½ in.	$\frac{3}{16}$ in.
Dust	¼ in.	..	$\frac{3}{16}$ in.	..

PERCENTAGES OF STANDARD SIZES IN RUN OF MINE

Size.	Per cent.
Lump	14.0
Stove or egg	16.4
Nut	10.1
Pea	23.9
Dust	35.8
Total	100.2
Slack	59.7
Nut slack	69.6

COALS AS RECEIVED. ASH ANALYSIS OF EACH SIZE

Size.	Number of Sample.	Per cent. Ash.	
		R.	A.D.
Run of mine	1a	10.4	10.6
Lump	1b	8.0	8.0
Egg	1c	11.8	12.1
Nut	1d	13.3	13.6
Pea	1e	11.2	11.5
Dust	1f	11.7	12.0

BREAKAGE LOSSES DUE TO SCREENING

Bituminous coals are only being stored as run of mine, so it is not necessary to get breakage losses due to screening operations in order to obtain correct breakage due to weathering. Breakage due to rehandling and rescreening.

Size.	Per cent. loss perforated screen.
Lump (Breakage was 88 lbs. in 544 lbs.)	16%
Egg (Breakage was 219 lbs. in 513 lbs.)	30%

Bituminous coal stored only as run of mine (see section (1) above for analysis).

HUMBERSTONE COAL

Locality .... Clover Bar District.
Kind of coal .... Domestic.
Date received .... December 15, 1920.

Coal received in three sizes.

(1) Egg
(2) Nut
(3) Slack

ANALYSIS OF COAL AS RECEIVED

Sample.	Egg.		Nut.		Pea.	
	R.	A.D.	R.	A.D.	R.	A.D.
(a) Loss on air drying	3.6	....	4.6	....	5.4	....
(b) Moisture	19.4	16.6	21.2	17.4	22.3	17.9
(c) Volatile matter	33.2	34.5	30.7	32.2	30.4	32.1
(d) Ash	9.0	9.2	8.8	9.2	10.5	11.1
(e) Fixed carbon	38.3	39.7	39.3	41.2	36.6	38.9
(f) Calories	4954	5138	4770	5000	4510	4873
(g) B.T.U. per pound	8920	9250	8590	9000	8310	8780

EQUIVALENCY TESTS

	SCREENS Standard Perforated.		Bar.	
	Through.	Over.	Through.	Over.
Lump	..	3 in.	..	2 in.
Stove or egg	3 in.	1½ in.	2 in.	¾ in.
Nut	1½ in.	¾ in.	¾ in.	½ in.
Pea	¾ in.	¼ in.	½ in.	Lessthan ¼ in.
Dust	¼ in.	..	Lessthan ¼ in.	..
Slack	¾ in.	..	½ in.	..
Nut slack	1½ in.	..	¾ in.	..

Remarks

No lump coal received for this test. Following Bar screen spacing would practically give an equivalency for Pea and Dust sizes above.

	Bar Screen.	
	Through.	Over.
Pea	½ in.	$\frac{3}{16}$ in.
Dust	$\frac{3}{16}$ in.	..

Coal received in three sizes so percentage of sizes in run of mine was not determined.

For percentage of ash in each size see section 1, line (d) above.

Breakage losses due to screening.

1. Egg:
   207 lbs. loss on 653 lbs. 31.7%.
2. Nut:
   30 lbs. loss on 224 lbs. 13.4%.
3. Pea:
   15.5 lbs. loss on 394.5 lbs. 3.9%.

NOTE:—Between first screening test and second test to show breakage, this coal was stored in the Mining Laboratory under conditions which were rather severe on a comparatively high moisture coal as this laboratory was steam heated and dry. Before the second test a noticeable cracking or opening up of the lumps took place, which rendered the coal much more tender to handling than it would have been under ordinary conditions of storage.

UNIVERSITY OF ALBERTA

EVAPORATION TEST

Test No. B-4.

Made at University of Alberta, Plant No. 2, Edmonton.

Date, January 11th, 1921.

Item No.

1. Duration of Test .... 8 hours
2. Type of Boilers—Babcock & Wilcox Water Tube Dutch Oven.
3. Builders Rating—2197 sq. ft. Heating Surface 44 sq. ft. Grate 220 h.p.
4. Method of Firing—Hand.
5. Kind of Coal used—Humberstone Nut.
6. Cost of Fuel Per Ton at Bunker—Market Value $5.75
7. Calorific Value of Fuel as Fired—B.T.U. per lb 8900
8. % of Moisture 24.7
9. Total Coal Fired (Wet) .... 12551 lbs.
10. Total Coal Fired (Dry) .... 9451 lbs.
11. Average Coal Consumption Per Hour .... 1569 lbs.
12. Ash, Clinker and Refuse .... 1187 lbs.
13. Total Combustible .... 8264 lbs.

AVERAGE PRESSURE AND TEMPERATURES

14. Steam Pressure Gauge 146.6
15. Temperature Feed Water 163.7
16. Pressure under Fire .... Inches of Water ....
17. Draft over Fire .... Inches of Water 0.74
18. Barometer .... Inches of Mercury 27.58

WATER

19. Total Water Evaporated at 163.7 Degrees F. Coal as Fired 62430
20. Water Evaporated Per Hour 7800
21. Total Equiv. Evap. From and at 212 Degrees F. 67450
22. Hourly Equiv. Evap. From and at 212 Degrees F. 8430

ECONOMIC RESULTS

23. Water Evaporated Per Pound of Coal (Actual Conditions) 4.97
24. Equiv. Evaporation Per Pound of Coal From and at 212 Degrees F. 5.37
25. Equiv. Evaporation Per Pound of Coal (Dry) From and at 212 Degrees F. 7.13
26. Equiv. Evaporation Per Pound of Coal (Combustible) From and at 212 Degrees F. 8.16
27. Cost of Evaporation per 1,000 pounds Water 53.5c
28. Cost of Steam per H.P. Hour 1.85c
29. Factor of Evaporation 1.081

EFFICIENCY

30. Efficiency of Boiler and Furnace—per cent 58.4
31. H.P. Developed Per Hour 244
32. Percentage of Builders Rating 111

ANALYSIS OF FUEL AS FIRED

Ultimate	Per cent.	Proximate.	Per cent.
a. Carbon		f. Fixed Carbon	39.6
b. Hydrogen		g. Volatile Matter	28.8
c. Ash		h. Ash	6.9
d. Sulphur		i. Moisture	24.7
e. Oxygen and Nitrogen (by difference)			

(Signed) CHARLES A. ROBB,
Assoc. Prof. Mech. Eng.

UNIVERSITY OF ALBERTA

EVAPORATION TEST

Test No. B-5

Made at University of Alberta, Plant No. 2, Edmonton.
Date, January 13, 1921.

Test No.

1.	Duration of Test	8 hours
2.	Type of Boilers—Babcock & Wilcox Water Tube.	
3.	Builders Rating—2197 sq. ft. Heating Surface 60 sq. ft. Grate 220 h.p.	
4.	Method of Firing—B. & W. Special chain grate Stoker close link.	
5.	Kind of Coal used—Humberstone Slack.	
6.	Cost of Fuel Per Ton at Bunker—Market value	$3.50
7.	Calorific Value of Fuel as Fired	8150
8.	% of Moisture	22.8
9.	Total Coal Fired (Wet)	16839 lbs.
10.	Total Coal Fired (Dry)	13000 lbs.
11.	Average Coal Consumption Per Hour	2105 lbs.
12.	Ash, Clinker and Refuse	3266 lbs.
13.	Total Combustible	9734 lbs.

AVERAGE PRESSURE AND TEMPERATURES

14.	Steam Pressure Gauge		149.6
15.	Temperature Feed Water		172.4
16.	Pressure under Fire	Inches of Water	
17.	Draft over Fire	Inches of Water	.65
18.	Barometer	Inches of Mercury	27.5

WATER

19.	Total Water Evaporated at 172.4 Degrees F. Coal as Fired	77500
20.	Water Evaporated Per Hour	9690
21.	Total Equiv. Evap. From and at 212 Degrees F.	83100
22.	Hourly Equiv. Evap. From and at 212 Degrees F.	10390

ECONOMIC RESULTS

23.	Water Evaporated Per Pound of Coal (Actual Conditions)	4.6
24.	Equiv. Evaporation Per Pound of Coal From and at 212 Degrees F.	4.93
25.	Equiv. Evaporation Per Pound of Coal (Dry) From and at 212 Degrees F.	6.39
26.	Equiv. Evaporation Per Pound of Coal (Combustible) From and at 212 Degrees F.	8.54
27.	Cost of Evaporation per 1,000 pounds Water	35.5c
28.	Cost of Steam per H.P. Hour	1.22c
29.	Factor of Evaporation	1.072

EFFICIENCY

30.	Efficiency of Boiler and Furnace—per cent.	58.3
31.	H.P. Developed Per Hour	301
32.	Percentage of Builders Rating	137

ANALYSIS OF FUEL AS FIRED

Ultimate.	Per cent.	Proximate.	Per cent.
a. Carbon		f. Fixed Carbon	37.2
b. Hydrogen		g. Volatile Matter	26.7
c. Ash		h. Ash	13.4
d. Sulphur		i. Moisture	22.8
e. Oxygen and Nitrogen (by difference)			

(Signed) CHAS. A. ROBB,
Assoc. Prof. Mech. Eng.

SAMPLING OF COAL IN THE MINE

The Mines Branch is commencing a thorough investigation of Alberta coals, more particularly in the mines which ship in railroad cars. In order that this may be done in a systematic manner, and that all samples shall be collected under the same system, the following regulations have been adopted.

PRELIMINARY DETAILS

The person collecting the sample shall first obtain a copy of the plan showing the workings of the mine to be sampled; go over same with the overman or manager; locate the section or sections from which coal is being mined at that time; and then determine as to the places from which he intends to take samples and mark these places on the plan.

NUMBER OF SAMPLES TO BE COLLECTED

The number of samples collected shall not be less than four from any mine producing two hundred tons or less per day, and increased at the rate of one sample for each additional two hundred tons of coal mined per day. These samples shall be collected from different portions of the mine, in order to give an average of the product shipped.

SELECTING PLACES FOR SAMPLING

Having decided upon the number of samples to be collected, and the location of same (should there be any necessity of changing the location the changed location should be noted on the map). Samples shall not be taken near faults, except when special study of the coal at these places is desirable.

METHODS OF SAMPLING

Cleaning Off the Face of the Coal

At each selected point, before a sample is cut, the face of the bed shall be cleared of burned powder, dirt, or loose coal from roof to floor for a width of about five ft. This is done to prevent any loose fragments or foreign matter from falling off the face of the coal on to the sampling cloth. Insecure pieces of the roof shall also be taken down in advance for the same purpose. In the middle of this cleared area on the face, the coal shall be cut away with the pick from the roof to the floor for a width of one ft. and a depth of at least one in., with a view to removing any discolored, altered, or otherwise inferior coal that might be near the surface, and also to square up this portion of the face in preparation for the sampling cut.

What to Include in the Sample

There shall go into the sample, as it is cut from the face, all the material that ordinarily goes into the daily shipments of coal. Usually partings more than three-eighths of an inch thick, and lenses or concretions of sulphur or other impurities more than two inches in maximum diameter and one-half inch thick, are excluded, if in the judgment of the sampler they are being excluded by the miner from the coal as loaded out of the mine or as shipped. Where

the impurity to be rejected, like bone or slaty coal, does not show conspicuously, it is advisable to outline the impurity with chalk before cutting the sample, to prevent its being overlooked when the sample is being cut.

Imitating the miner in excluding impurities is the best method, but this requires care and judgment, especially where the partings are soft and crumble. Since it is desired to obtain samples that represent as nearly as possible the coal that is produced commercially from the mine under examination, this method must be followed as closely and as uniformly as possible. The carrying out of this method demands the exercise of judgment and experience on the part of the sampler, and he must familiarize himself with the impurities in the coal bed and their relation to the coal as shipped.

Collecting and Preparing the Sample

The collector shall smooth and clean the floor and spread the sampling cloth on it close to the face of the coal. Then he shall make a perpendicular cut two in. deep and six in. wide (or three in. deep and four in. wide in the softer coals) from the roof to the floor down the middle of the foot-wide cut previously made in the coal face. He shall be careful to make this cut uniform in width and depth, and shall chip off enough coal to make a sample weighing at least six lbs. for each foot of the thickness of the bed; so that the sample collected on the blanket from a six ft. bed will weigh not less than 36 lbs.

As soon as the cutting of the sample has been completed, the lumps shall be broken until all the sample will pass through a ½-inch mesh screen. The sample shall then be thoroughly mixed by two men grasping the opposite corners of the blanket and rolling it diagonally by raising one corner at a time. When the larger pieces of coal are evenly distributed throughout the mass, the sheet shall be laid on the floor and the top of the pile flattened with a clean dry shovel, trowel, or board. The sample is then quartered, and two opposite quarters are discarded and brushed off. The remainder is mixed as before, and if the sample is still too bulky for convenient handling it is again quartered down. The material finally remaining is spread into a circular mass about two in. deep on the sheet, and the sampling scoop is used to fill the sample can compactly with portions from opposite quarters. The entire operation described above, from the cutting of the sample to the sealing of the can, shall be done in the mine, so as not to expose the coal to the outside atmosphere.

The Can Should be Completely Filled

It is important that the coal be well packed in the can, so as to occupy as much of the space as possible, since in this way the air is more nearly excluded. This is best accomplished by crushing fine a considerable proportion of the coal, and by shaking or jarring the can repeatedly and vigorously while filling it.

Sealing the Can

As soon as the can has been filled and the label (described below) placed inside, the cap shall be screwed on so that the top of the screw fits tightly into the rubber or other flexible material in the cap;

adhesive tape shall then be carefully wrapped around the lower edge of the cap, in such a manner as to cover the joint and increase the thoroughness of the sealing.

Labelling

Before sealing the sample, a label shall be placed in it on top of the coal presenting sample number, name, and location of mine; and the exact location in the mine from which the sample was taken, the name of the collector and the date. On the outside of the can a label shall be placed bearing the same number, the name of the collector, the date of collection, and addressed to Mr. James A. Kelso, of the University of Alberta, Edmonton South. The number placed on the label inside of the can and on the outside shall be placed on the sheet giving the description of the mine and coal seam; also other further particulars required, which shall be forwarded to Mr. James A. Kelso, of the University of Alberta, and the Mines Branch, Edmonton, at the same time the sample is forwarded.

Collecting Outfit or Sampling Kit

The coal-mine sampling outfit comprises the following articles: Carrying bag, sampling cloth (heavy oilcloth), sampling scoop, measuring tape, whisk broom, sample cans, adhesive tape.

ALBERTA COAL FIELDS

LETHBRIDGE AREA

Description.	Chinook Coal Co., Ltd., Commerce. Sec. 12, Tp. 10, R. 22.					
Sample No.	No. 1			No. 2		
Moisture condition (see note p. 2)	R.	A.D.	D.	R.	A.D.	D.
Loss on air-drying . . %	0.5	....	....	2.0	....	....
Proximate analysis:—						
Moisture . . . . %	10.1	9.6	....	9.8	8.0	....
Volatile matter . . %	33.0	33.2	36.7	33.6	34.2	37.1
Fixed carbon . . . . %	47.1	47.4	52.4	42.8	43.8	47.6
Ash . . . . %	9.8	9.8	10.9	13.8	14.0	15.3
B.T.U. per lb. gross	10,755	10,810	11,960	10,300	10,510	11,420
Location in mine	Face of No. 14 room 5th butt entry.			Face of No. 1 butt entry 3rd N.W.		
Taken by	Moses Johnson, Dist. Insp. of Mines, Lethbridge.			Moses Johnson, Dist. Insp. of Mines, Lethbridge.		
Date of sampling	November 4, 1920.			November 4, 1920.		

Sample No.	No. 3			No. 4		
Moisture condition (see note p. 2)	R.	A.D.	D.	R.	A.D.	D.
Loss on air-drying . . %	1.0	....	....	1.0	....	....
Proximate analysis:—						
Moisture . . . . %	9.4	8.5	....	8.7	7.8	....
Volatile matter . . %	33.5	33.8	36.9	33.5	33.8	36.6
Fixed carbon . . . . %	47.0	47.5	51.9	48.7	49.2	53.4
Ash . . . . %	10.1	10.2	11.2	9.1	9.2	10.0
B.T.U. per lb. gross	10,685	10,790	11,790	10,880	10,990	11,920
Location in mine	Face of No. 5 room off 1st butt entry S.W.			Face of counter No. 3 southwest face entry.		
Taken by	Moses Johnson, Dist. Insp. of Mines, Lethbridge.			Moses Johnson, Dist. Insp. of Mines, Lethbridge.		
Date of sampling	November 5, 1920.			November 5, 1920.		

Sample No.	No. 5		
Moisture condition (see note p. 2)	R.	A.D.	D.
Loss on air-drying . . . . %	0.5	....	....
Proximate analysis:—			
Moisture . . . . %	8.6	8.1	....
Volatile matter . . . . %	32.7	32.9	35.8
Fixed carbon . . . . %	48.6	48.9	53.2
Ash . . . . %	10.1	10.1	11.0
B.T.U. per lb. gross	10,745	10,800	11,750
Location in mine	Face of No. 6 room off 7th butt entry.		
Taken by	Moses Johnson, Dist. Insp. of Mines, Lethbridge.		
Date of sampling	November 5, 1920		

Note p. 2—R.—Fuel as received.
A.D.—Air dried fuel.
D.—Fuel dried at 105° C.

ALBERTA COAL FIELDS

LETHBRIDGE AREA

Description.	Federal Coals, Ltd., Lethbridge. L.S. 5, Sec. 36, Tp. 8, R. 22					
Sample No.	No. 6			No. 7		
Moisture condition (see note p. 2)	R.	A.D.	D.	R.	A.D.	D
Loss on air-drying . . %	2.0	....	....	3.0	....	....
Proximate analysis:—						
Moisture %	10.2	8.4	....	9.5	6.7	....
Volatile matter %	32.6	33.2	36.3	33.2	34.2	36.6
Fixed carbon %	48.9	49.9	54.4	48.5	50.0	53.6
Ash %	8.3	8.5	9.3	8.8	9.1	9.8
Ultimate analysis:—						
Carbon %	64.7	66.0	71.8	63.2	65.2	69.9
Hydrogen %	4.9	4.8	4.4	4.8	4.6	4.2
Ash %	8.3	8.5	9.3	8.8	9.1	9.8
Sulphur %	0.5	0.5	0.5	0.5	0.5	0.5
Nitrogen %	1.9	1.9	2.1	1.8	1.8	1.9
Oxygen %	19.7	18.3	11.9	20.9	18.8	13.7
B.T.U. per lb. gross.	10,770	10,990	12,000	10,770	11,100	11,900
Location in mine	Face of east butt entry			Face of crosscut off north mine entry.		
Taken by	Moses Johnson, Dist. Insp. of Mines, Lethbridge.			Moses Johnson, Dist. Insp. of Mines, Lethbridge.		
Date of sampling	November 9, 1920.			November 9, 1920.		
Sample No.	No. 8			No. 9		
Moisture condition (see note p. 2)	R.	A.D.	D.	R.	A.D.	D.
Loss on air-drying . . %	1.0	....	....	3.0	....	....
Proximate analysis:—						
Moisture %	10.1	9.2	....	11.5	8.8	....
Volatile matter %	32.9	33.2	36.5	33.2	34.2	37.5
Fixed carbon %	49.5	50.0	55.1	47.7	49.2	53.9
Ash %	7.5	7.6	8.4	7.6	7.8	8.6
Ultimate analysis:—						
Carbon %	65.5	66.2	72.1	65.3	67.3	72.7
Hydrogen %	4.9	4.8	4.2	5.2	5.1	4.6
Ash %	7.5	7.6	8.4	7.6	7.8	8.6
Sulphur %	0.5	0.5	0.5	0.4	0.4	0.4
Nitrogen %	1.8	1.8	2.0	1.8	1.8	1.9
Oxygen %	19.8	19.1	12.8	19.7	17.6	11.8
B.T.U. per lb. gross	10,740	10,850	11,950	10,545	10,870	11,920
Location in mine	Face of No. 2 room off main entry.			Face of No. 1 entry off south butt entry.		
Taken by	Moses Johnson, Dist. Insp. of Mines, Lethbridge.			Moses Johnson, Dist. Insp. of Mines, Lethbridge.		
Date of sampling	November 9, 1920.			November 9, 1920.		

ALBERTA COAL FIELDS

LETHBRIDGE AREA

Description.	Lethbridge Coal Co., Ltd., Lethbridge. L.S. 12, Sec. 12, Tp. 9, R. 22.					
Sample No.	No. 10			No. 11		
Moisture condition (see note p. 2)	R.	A.D.	D.	R.	A.D.	D.
Loss on air-drying . . %	1.4	....	....	1.6	....	....
Proximate analysis:—						
Moisture . . . %	9.5	8.2	....	9.6	8.1	....
Volatile matter . . %	34.3	34.7	37.8	34.1	34.6	37.6
Fixed carbon . . . %	47.5	48.2	52.5	48.5	49.3	53.6
Ash . . . %	8.7	8.9	9.7	7.8	8.0	8.8
Ultimate analysis:—						
Carbon . . . %	....	....	....	65.1	66.2	72.0
Hydrogen . . . %	....	....	....	4.9	4.8	4.3
Ash . . . %	....	....	....	7.8	8.0	8.8
Sulphur . . . %	....	....	....	0.4	0.4	0.4
Nitrogen . . . %	....	....	....	1.8	1.8	2.0
Oxygen . . . %	....	....	....	20.0	18.8	12.5
B.T.U. per lb. gross	10,710	10,860	11,830	10,925	11,100	12,080
Location in mine . . .	Face of No. 6 room 1st butt right entry.			Face of crosscut No. 2 room 2nd butt right.		
Taken by . . .	Moses Johnson, Dist. Insp. of Mines, Lethbridge.			Moses Johnson, Dist. Insp. of Mines, Lethbridge.		
Date of sampling . . .	November 11, 1920.			November 11, 1920.		

Sample No.	No. 12			No. 13		
Moisture condition (see note p. 2)	R.	A.D.	D.	R.	A.D.	D.
Loss on air-drying . . %	1.0	....	....	1.5	....	....
Proximate analysis:—						
Moisture . . . %	9.7	8.8	....	10.5	9.2	....
Volatile matter . . %	33.2	33.5	36.7	32.3	32.8	36.1
Fixed carbon . . . %	47.5	48.0	52.6	49.2	49.9	54.9
Ash . . . %	9.6	9.7	10.7	8.0	8.1	9.0
Ultimate analysis:—						
Carbon . . . %	....	....	....	65.8	66.8	73.5
Hydrogen . . . %	....	....	....	4.9	4.8	4.2
Ash . . . %	....	....	....	8.0	8.1	9.0
Sulphur . . . %	....	....	....	0.5	0.5	0.5
Nitrogen . . . %	....	....	....	1.7	1.7	1.8
Oxygen . . . %	....	....	....	19.1	18.1	11.0
B.T.U. per lb. gross	10,800	10,910	11,950	10,825	10,990	12,100
Location in mine . . .	Face of No. 1 room off 4th butt entry.			Face of 3rd left butt entry.		
Taken by . . .	Moses Johnson, Dist. Insp. of Mines, Lethbridge.			Moses Johnson, Dist. Insp. of Mines, Lethbridge.		
Date of sampling . . .	November 11, 1920.			November 11, 1920.		

ALBERTA COAL FIELDS

LETHBRIDGE AREA

Description.	The Canada West Coal Co., Ltd., Taber, L.S. 7, Sec. 31, Tp. 9, R. 16.					
Sample No.	No. 14			No. 15		
Moisture condition (see note p. 2)	R.	A.D.	D.	R.	A.D.	D.
Loss on air-drying . . %	0.8	....	....	1.0	....	....
Proximate analysis:—						
Moisture . . . %	12.8	12.1	....	12.9	12.0	....
Volatile matter . . . %	33.0	33.2	37.8	32.1	32.4	36.8
Fixed carbon . . . %	43.5	43.9	50.0	45.3	45.8	52.1
Ash . . . %	10.7	10.8	12.2	9.7	9.8	11.1
B.T.U. per lb. gross	9,900	9,980	11,355	10,020	10,120	11,500
Location in mine	Face of No. 22 room off 22nd west entry.			Face of No. 35 room off 23rd east entry.		
Taken by	Moses Johnson, Dist. Insp. of Mines, Lethbridge.			Moses Johnson, Dist. Insp. of Mines, Lethbridge.		
Date of sampling	November 24, 1920.			November 24, 1920.		

Sample No.	No. 16			No. 17		
Moisture condition (see note p. 2)	R.	A.D.	D.	R.	A.D.	D.
Loss on air-drying . . %	1.0	....	....	1.0	....	....
Proximate analysis:—						
Moisture . . . %	12.3	11.4	....	13.5	12.6	....
Volatile matter . . %	31.6	31.9	36.0	32.5	32.8	37.4
Fixed carbon . . . %	43.8	44.3	50.0	46.9	47.4	54.3
Ash . . . %	12.3	12.4	14.0	7.1	7.2	8.3
B.T.U. per lb. gross	9,720	9,820	11,085	10,230	10,330	11,810
Location in mine	No. 12 room off 7th west entry.			No. 8 room off 9th east entry.		
Taken by	Moses Johnson, Dist. Insp. of Mines, Lethbridge.			Moses Johnson, Dist. Insp. of Mines, Lethbridge.		
Date of sampling	November 24, 1920.			November 24, 1920.		

Sample No.		No. 18	
Moisture condition (see note p. 2)	R.	A.D.	D.
Loss on air-drying . . . %	1.2	....	....
Proximate analysis:—			
Moisture . . . %	14.2	13.1	....
Volatile matter . . . %	32.8	33.2	38.2
Fixed carbon . . . %	43.1	43.7	50.4
Ash . . . %	9.9	10.0	11.4
B.T.U. per lb. gross	9,890	10,010	11,500
Location in mine	Face of 3rd east entry.		
Taken by	Moses Johnson, Dist. Insp. of Mines, Lethbridge.		
Date of sampling	November 24, 1920.		

ALBERTA COAL FIELDS

LETHBRIDGE AREA

Description	The Regal Collieries, Ltd., Taber, L.S. 8, Sec. 19, Tp. 10, R. 16.					
Sample No.	No. 19			No. 20		
Moisture condition (see note p. 2)	R.	A.D.	D.	R.	A.D.	D.
Loss on air-drying . . %	1.5	....	....	1.0	....	....
Proximate analysis:—						
Moisture . . . %	13.0	11.7	....	14.9	14.0	....
Volatile matter . . %	31.8	32.3	36.6	31.6	31.9	37.1
Fixed carbon . . . . %	43.0	43.7	49.5	46.1	46.6	54.2
Ash . . . . %	12.2	12.3	13.9	7.4	7.5	8.7
B.T.U. per lb. gross	9,645	9,790	11,085	10,130	10,230	11,890
Location in mine	Face of No. 1 main east entry.			Face of No. 4 west entry.		
Taken by	Moses Johnson, Dist. Insp. of Mines, Lethbridge.			Moses Johnson, Dist. Insp. of Mines, Lethbridge.		
Date of sampling	November 25, 1920.			November 25, 1920.		

Sample No.	No. 21			No. 22		
Moisture condition (see note p. 2)	R.	A.D.	D.	R.	A.D.	D.
Loss on air-drying . . %	2.0	....	....	0.8	....	....
Proximate analysis:—						
Moisture . . . %	13.9	12.1	....	13.6	12.9	....
Volatile matter . . %	32.2	32.8	37.3	31.9	32.1	37.0
Fixed carbon . . . . %	46.1	47.1	53.6	43.8	44.2	50.7
Ash . . . . %	7.8	8.0	9.1	10.7	10.8	12.3
B.T.U. per lb. gross	10,085	10,290	11,710	9,850	9,930	11,400
Location in mine	Face of No. 2 room No. 3 east entry.			Longwall face between 17 and 18 gateways.		
Taken by	Moses Johnson, Dist. Insp. of Mines, Lethbridge.			Moses Johnson, Dist. Insp. of Mines, Lethbridge.		
Date of sampling	November 25, 1920.			November 25, 1920.		

ALBERTA COAL FIELDS

CROW'S NEST PASS AREA

Description.	Hillcrest Collieries, Ltd., Hillcrest. Sec. 17, Tp. 7, R. 3.					
Sample No.	No. 23			No. 24		
Moisture condition (see note p. 2)	R.	A.D.	D.	R.	A.D.	D.
Loss on air-drying .. %	2.0	....	....	0.1	....	....
Proximate analysis:—						
Moisture %	3.3	1.3	....	1.0	0.9	....
Volatile matter %	28.4	28.9	29.2	26.5	26.5	26.7
Fixed carbon %	53.7	54.8	55.6	58.5	58.6	59.1
Ash %	14.6	15.0	15.2	14.0	14.0	14.2
Ultimate analysis:—						
Carbon %	69.4	70.8	71.8	70.7	70.8	71.4
Hydrogen %	3.9	3.8	3.8	3.8	3.8	3.8
Ash %	14.6	15.0	15.2	14.0	14.0	14.2
Sulphur %	0.4	0.4	0.4	0.5	0.5	0.5
Nitrogen %	1.1	1.1	1.1	1.1	1.1	1.1
Oxygen %	10.6	8.9	7.9	9.9	9.8	9.0
B.T.U. per lb. gross	12,290	12,540	12,700	12,740	12,750	12,870
Location in mine	No. 249 room off No. 2 south entry.			Face of No. 3 south entry near No. 385 room.		
Taken by	James Crowder, Dist. Insp. of Mines, Blairmore.			James Crowder, Dist. Insp. of Mines, Blairmore.		
Date of sampling	October 26, 1920.			October 26, 1920.		

ALBERTA COAL FIELDS

CROW'S NEST PASS AREA

Description.	Hillcrest Collieries, Ltd., Hillcrest. Sec. 17, Tp. 7, R. 3.					
Sample No.	No. 25			No. 26		
Moisture condition (see note p. 2)	R.	A.D.	D.	R.	A.D.	D.
Loss on air-drying . . %	0.8	....	....	0.5	....	....
Proximate analysis:—						
Moisture . . . . %	1.1	0.3	....	1.4	0.9	....
Volatile matter . . %	27.4	27.6	27.7	26.4	26.5	26.7
Fixed carbon . . . . %	56.6	57.1	57.3	58.1	58.4	58.9
Ash . . . . %	14.9	15.0	15.0	14.1	14.2	14.4
B.T.U. per lb. gross	12,620	12,720	12,770	12,725	12,790	12,905
Location in mine	Face of No. 405 room off No. 4 north level.			Face of No. 4 south level.		
Taken by	James Crowder, Dist. Insp. of Mines, Blairmore.			James Crowder, Dist. Insp. of Mines, Blairmore.		
Date of sampling	November 3, 1920.			November 3, 1920.		
Sample No.	No. 27			No. 28		
Moisture condition (see note p. 2)	R.	A.D.	D.	R.	A.D.	D.
Loss on air-drying . . %	0.8	....	....	0.8	....	....
Proximate analysis:—						
Moisture . . . . %	2.0	1.2	....	1.2	0.4	....
Volatile matter . . %	26.5	26.7	27.0	25.0	25.2	25.3
Fixed carbon . . . . %	54.4	54.9	55.6	57.6	58.1	58.3
Ash . . . . %	17.1	17.2	17.4	16.2	16.3	16.4
B.T.U. per lb. gross	12,270	12,370	12,520	12,490	12,590	12,640
Location in mine	Face of No. 555 room off No. 5 south level.			No. 111 pillar off No. 6 north level.		
Taken by	James Crowder, Dist. Insp. of Mines, Blairmore.			James Crowder, Dist. Insp. of Mines, Blairmore.		
Date of sampling	November 3, 1920.			November 4, 1920.		

ALBERTA COAL FIELDS

CROW'S NEST PASS AREA

Description.	Hillcrest Collieries, Ltd., Hillcrest. Sec. 17, Tp. 7, R. 3.					
Sample No.	No. 29			No. 30		
Moisture condition (see note p. 2)	R.	A.D.	D.	R.	A.D.	D.
Loss on air-drying . . %	0.8	....	....	0.5	....	....
Proximate analysis:—						
Moisture . . %	1.1	0.3	....	1.0	0.5	....
Volatile matter . . %	26.0	26.2	26.3	27.0	27.2	27.4
Fixed carbon . . %	63.6	64.3	64.5	62.2	62.5	62.8
Ash . . %	9.3	9.2	9.2	9.8	9.8	9.8
B.T.U. per lb. gross	13,470	13,580	13,620	13,460	13,530	13,600
Location in mine	No. 18 off No. 1 north level.			No. 205 room off No. 2 north level.		
Taken by	James Crowder, Dist. Insp. of Mines, Blairmore.			James Crowder, Dist. Insp. of Mines, Blairmore.		
Date of sampling	November 4, 1920.			November 4, 1920.		
Sample No.	No. 31			No. 32		
Moisture condition (see note p. 2)	R.	A.D.	D.	R.	A.D.	D.
Loss on air-drying . . %	0.8	....	....	0.7	....	....
Proximate analysis:—						
Moisture . . %	1.2	0.4	....	1.1	0.4	....
Volatile matter . . %	24.4	24.6	24.7	26.0	26.2	26.3
Fixed carbon . . %	63.6	64.1	64.3	58.8	59.2	59.4
Ash . . %	10.8	10.9	11.0	14.1	14.2	14.3
B.T.U. per lb. gross	13,290	13,400	13,455	12,700	12,790	12,840
Location in mine	Face No. 305 room off 3rd north level.			Taken off picking table on surface.		
Taken by	James Crowder, Dist. Insp. of Mines, Blairmore.			James Crowder, Dist. Insp. of Mines, Blairmore.		
Date of sampling	November 4, 1920.			November 8, 1920.		

ALBERTA COAL FIELDS

CROW'S NEST PASS AREA

Description.	West Canadian Collieries, Ltd., Bellevue. Sec. 32, Tp. 7, R. 3.					
Sample No.	No. 33			No. 34		
Moisture condition (see note p. 2)	R.	A.D.	D.	R.	A.D.	D.
Loss on air-drying . . %	1.0	....	....	1.0	....	....
Proximate analysis:—						
Moisture %	1.5	0.5	....	1.5	0.5	....
Volatile matter %	26.1	26.4	26.5	26.2	26.5	26.6
Fixed carbon %	60.0	60.6	60.9	56.1	56.7	57.0
Ash %	12.4	12.5	12.6	16.2	16.3	16.4
Ultimate analysis:—						
Carbon %	73.6	74.3	74.7	69.2	69.9	70.3
Hydrogen %	4.2	4.1	4.0	4.0	3.9	3.8
Ash %	12.4	12.5	12.6	16.2	16.3	16.4
Sulphur %	0.6	0.6	0.6	0.6	0.6	0.6
Nitrogen %	1.1	1.1	1.1	1.1	1.1	1.1
Oxygen %	8.1	7.4	7.0	8.9	8.2	7.8
B.T.U. per lb. gross	12,840	12,970	13,035	12,465	12,570	12,635
Location in mine	Face of No. 11 room off No. 7 north level.			Face No. 41 room off No. 7 north level.		
Taken by	James Crowder, Dist. Insp. of Mines, Blairmore.			James Crowder, Dist. Insp. of Mines, Blairmore.		
Date of sampling	October 13, 1920.			October 13, 1920.		

Description.						
Sample No.	No. 35			No. 36		
Moisture condition (see note p. 2)	R.	A.D.	D.	R.	A.D.	D.
Loss on air-drying . . %	1.6	....	....	0.6	....	....
Proximate analysis:—						
Moisture %	2.1	0.6	....	1.1	0.5	....
Volatile matter %	27.7	28.1	28.3	26.6	26.8	26.9
Fixed carbon %	56.2	57.1	57.4	56.2	56.5	56.8
Ash %	14.0	14.2	14.3	16.1	16.2	16.3
Ultimate analysis:—						
Carbon %	71.0	72.2	72.6	69.9	70.3	70.4
Hydrogen %	4.2	4.0	3.9	4.1	4.0	3.9
Ash %	14.0	14.2	14.3	16.1	16.2	16.3
Sulphur %	0.5	0.5	0.5	0.6	0.6	0.6
Nitrogen %	1.1	1.1	1.1	1.1	1.1	1.1
Oxygen %	9.2	8.0	7.6	8.2	7.8	7.4
B.T.U. per lb. gross	12,580	12,790	12,870	12,495	12,570	12,635
Location in mine	Face of No. 7 north main level.			No. 38 room off No. 7 south level.		
Taken by	James Crowder, Dist. Insp. of Mines, Blairmore.			James Crowder, Dist. Insp. of Mines, Blairmore.		
Date of sampling	October 13, 1920.			October 13, 1920.		

ALBERTA COAL FIELDS

CROW'S NEST PASS AREA

Description.	West Canadian Collieries, Ltd., Bellevue. Sec. 32, Tp. 7, R. 3.					
Sample No.	No. 37			No. 38		
Moisture condition (see note p. 2)	R.	A.D.	D.	R.	A.D.	D.
Loss on air-drying . . %	1.0	....	....	2.0	....	....
Proximate analysis:—						
Moisture %	1.5	0.5	....	2.5	0.6	....
Volatile matter %	25.5	25.8	25.9	23.6	24.1	24.2
Fixed carbon %	56.5	57.1	57.4	58.1	59.2	59.6
Ash %	16.5	16.6	16.7	15.8	16.1	16.2
Ultimate analysis:—						
Carbon %	68.5	69.2	69.6	69.7	71.1	71.5
Hydrogen %	3.8	3.7	3.6	4.0	3.9	3.8
Ash %	16.5	16.6	16.7	15.8	16.1	16.2
Sulphur %	0.6	0.6	0.6	0.6	0.6	0.6
Nitrogen %	1.1	1.1	1.1	1.1	1.1	1.1
Oxygen %	9.5	8.8	8.4	8.8	7.2	6.8
B.T.U. per lb. gross	12,375	12,500	12,565	12,320	12,570	12,650
Location in mine	Taken off picking table on surface.			No. 2 crosspitch south No. 11, No. 125 district.		
Taken by	James Crowder, Dist. Insp. of Mines, Blairmore.			James Crowder, Dist. Insp. of Mines, Blairmore.		
Date of sampling.	October 13, 1920.			October 14, 1920.		

Sample No.	No. 39			No. 40		
Moisture condition (see note p. 2.)	R.	A.D.	D.	R.	A.D.	D.
Loss on air-drying . . %	2.8	....	....	1.2	....	....
Proximate analysis:—						
Moisture %	3.5	0.7	....	1.8	0.6	....
Volatile matter %	24.6	25.3	25.5	25.1	25.4	25.6
Fixed carbon %	56.5	58.1	59.5	56.8	57.5	57.8
Ash %	15.4	15.9	16.0	16.3	16.5	16.6
Ultimate analysis:—						
Carbon %	69.1	71.1	71.6	67.4	68.2	68.6
Hydrogen %	4.0	3.8	3.7	3.7	3.6	3.5
Ash %	15.4	15.9	16.0	16.3	16.5	16.6
Sulphur %	0.5	0.5	0.5	0.5	0.5	0.5
Nitrogen %	1.1	1.1	1.1	1.1	1.1	1.1
Oxygen %	7.9	7.6	7.1	11.0	10.1	9.7
B.T.U. per lb. gross	12,255	12,600	12,670	12,360	12,510	12,595
Location in mine	No. 4 crosspitch off No. 11 in No. 125 District.			Taken off picking table on surface.		
Taken by	James Crowder, Dist. Insp. of Mines, Blairmore.			James Crowder, Dist. Insp. of Mines, Blairmore.		
Date of sampling	October 14, 1920.			October 14, 1920.		

ALBERTA COAL FIELDS

Crow's Nest Pass Area

Description.	West Canadian Collieries, Ltd., Bellevue. Sec. 32, Tp. 7, R. 3.					
Sample No.	No. 41			No. 42		
Moisture condition (see note p. 2)	R.	A.D.	D.	R.	A.D.	D.
Loss on air-drying . . %	1.4	....	....	1.2	....	....
Proximate analysis:—						
Moisture . . %	2.1	0.7	....	1.7	0.5	....
Volatile matter . . %	25.2	25.5	25.7	27.3	27.6	27.7
Fixed carbon . . %	58.0	58.8	59.2	56.3	57.0	57.3
Ash . . %	14.7	15.0	15.1	14.7	14.9	15.0
Ultimate analysis:—						
Carbon . . %	71.4	72.4	72.9	70.8	71.7	72.1
Hydrogen . . %	3.8	3.7	3.7	4.1	4.0	4.0
Ash . . %	14.7	15.0	15.1	14.7	14.9	15.0
Sulphur . . %	0.6	0.6	0.6	0.5	0.5	0.5
Nitrogen . . %	1.2	1.2	1.2	1.2	1.2	1.2
Oxygen . . %	8.3	7.1	6.5	8.7	7.7	7.2
B.T.U. per lb. gross	12,520	12,700	12,790	12,490	12,740	12,800
Location in mine	No. 152 pillar No. 4 level.			No. 141 pillar No. 4 level.		
Taken by	James Crowder, Dist. Insp. of Mines, Blairmore.			James Crowder, Dist. Insp. of Mines, Blairmore.		
Date of sampling	October 15, 1920.			October 15, 1920.		

ALBERTA COAL FIELDS

Crow's Nest Pass Area

Description.	West Canadian Collieries, Ltd., Bellevue. Sec. 32, Tp. 7, R. 3.					
Sample No.	No. 43			No. 44		
Moisture condition (see note p. 2)	R.	A.D.	D.	R.	A.D.	D.
Loss on air-drying . . %	1.8	....	....	1.2	....	....
Proximate analysis:—						
Moisture %	2.3	0.5	....	1.7	0.5	....
Volatile matter %	24.0	24.5	24.6	26.	27.2	27.3
Fixed carbon %	56.3	57.3	57.6	59.	59.7	60.0
Ash %	17.4	17.7	17.8	12.	12.6	12.7
B.T.U. per lb. gross	12,110	12,320	12,385	12,81.	12,970	13,035
Location in mine	No. 136 pillar No. 4 level.			No. 128 pillar No. 4 level.		
Taken by	James Crowder, Dist. Insp. of Mines, Blairmore.			James Crowder, Dist. Insp. of Mines, Blairmore.		
Date of sampling	October 15, 1920.			October 15, 1920.		

Description.						
Sample No.	No. 45			No. 46		
Moisture condition (see note p. 2)	R.	A.D.	D.	R.	A.D.	D.
Loss on air-drying . . %	1.0	....	....	1.0	....	....
Proximate analysis:—						
Moisture %	1.5	0.5	....	1.6	0.6	....
Volatile matter %	28.2	28.5	28.6	25.5	25.8	25.9
Fixed carbon %	58.2	58.8	59.2	55.9	56.5	56.9
Ash %	12.1	12.2	12.2	17.0	17.1	17.2
B.T.U. per lb. gross	12,970	13,100	13,170	12,245	12,370	12,445
Location in mine	No. 123½ room off No. 4 level.			Taken off picking table on surface.		
Taken by	James Crowder, Dist. Insp. of Mines, Blairmore.			James Crowder, Dist. Insp of Mines, Blairmore.		
Date of sampling	October 15, 1920.			October 15, 1920.		

ALBERTA COAL FIELDS

CROW'S NEST PASS AREA

Description.	Bellevue Collieries, Ltd., Maple Leaf, Bellevue. Sec. 21, Tp. 7, R.3					
Sample No.	No. 47			No. 48		
Moisture condition (see note p. 2)	R.	A.D.	D.	R.	A.D.	D.
Loss on air-drying . . %	1.6	....	....	2.0	....	....
Proximate analysis:—						
Moisture . . %	2.2	0.6	....	2.5	0.5	....
Volatile matter . . %	24.1	24.5	24.6	23.9	24.4	24.5
Fixed carbon . . %	55.6	56.5	56.9	48.3	49.3	49.6
Ash . . %	18.1	18.4	18.5	25.3	25.8	25.9
B.T.U. per lb. gross	11,915	12,110	12,180	11,110	11,340	11,395
Location in mine	Face of 450 foot level.			No. 3 pillar on 800 foot level.		
Taken by	James Crowder, Dist. Insp. of Mines, Blairmore.			James Crowder, Dist. Insp. of Mines, Blairmore.		
Date of sampling	October 21, 1920.			October 21, 1920.		

Sample No.	No. 49		
Moisture condition (see note p. 2)	R.	A.D.	D.
Loss on air-drying . . %	1.8	....	....
Proximate analysis:—			
Moisture . . %	2.4	0.6	....
Volatile matter . . %	24.0	24.4	24.5
Fixed carbon . . %	56.4	57.4	57.8
Ash . . %	17.2	17.6	17.7
B.T.U. per lb. gross	12,100	12,320	12,400
Location in mine	Face of 900 foot level.		
Taken by	James Crowder, Dist. Insp. of Mines, Blairmore.		
Date of sampling	October 21, 1920.		

SALT EXPLORATIONS AT FORT McMURRAY

By Professor John A. Allan

Close attention was given to operations at the salt well being drilled by the Provincial Government at Fort McMurray. The core rock was studied from time to time in the field, and all data carefully collected and correlated. The operation of testing the occurrence of salt in Northern Alberta, undertaken by the Provincial Government, has been, to say the least, successful. When drilling was stopped in November, 1920, the well had been sunk to a depth of 685½ ft. The well has been successful, in that there has been proved to exist 14 ft. of rock-salt, sufficiently pure in its present condition to be mined without treatment. There possibly occurs between 30 ft. and 35 ft. of beds sufficiently rich in salt to be mined within the lower 60 ft. of the well. The fact that most of the core below 630 ft. was washed away during drilling would seem to indicate that the formations consisted largely of rock salt.

The formations in this well are remarkably dry throughout, so that if the rock-salt were mined no difficulty should be encountered from water. Besides the rock-salt there are nearly 100 ft. of anhydrite and gypsum of commercial quality, and, if a market can be obtained for this mineral in any form, a large reserve is available for development.

The time required to drill this distance was much longer than was expected, but many problems were encountered and much difficulty resulted during the drilling which was not anticipated when the well was started. These difficulties were due, to a large extent, to the absolute lack of knowledge of the character of the formations through which the drill would pass. Repairs and changes in equipment had to be made from time to time, and this entailed considerable delay in getting the material from Edmonton, or in many cases from Eastern Canada. Furthermore, it was not the original intention to case the hole, but after a depth of 500 ft. had been reached it was found essential that casing should be used. This entailed a further delay. The well is now cased to a depth of 562 ft.

The core obtained from the calyx drill was carefully labelled and boxed at the well site. The complete core, which ranges from 10 ins. in diameter at the top to 3 ins. in diameter at the bottom, has been brought to the University of Alberta and arranged and exhibited in such a way that any portion of the strata can be examined in detail with the greatest convenience. A space has been alloted in the Mining Building at the University for the core, which will be permanently preserved.

The value of the information obtained from a detailed study of the rock core is too great to estimate, as this is the first complete accurate record which has been obtained of the formations in any part of Alberta.

One of the most important facts obtained from the study of this core is that so far as the fossils have been determined, the Upper Devonian beds are lying directly on the anhydrite, gypsum and rock-salt beds, which have always been regarded as of Silurian age. This

means that in the McMurray district there appears to be no Middle or Lower Devonian. This fact is of the greatest importance in the development for oil in Northern Alberta and the Lower McKenzie basin. Correlation of the strata obtained in the well has already been started with the data which have been obtained from the Great Slave Lake and Fort Norman fields. Even though no rock-salt had been found in this well, the geological data secured will be most valuable to the development of our mineral resources particularly in the north.

In order to make one full complete section of the strata at Fort McMurray, the well should be continued through the various formations to the granite. It is now important that other well records should be preserved in order to correlate the results with the section at Fort McMurray. Steps should be taken to have careful records kept of all wells put down in any part of the province, and the information correlated by the Provincial Geologist. The data which can be obtained from a well drilled with ordinary standard tools are by no means as accurate as those from one in which a rock core has been taken; but complete records from any well drilled are more valuable than no data.

PROGRAMME OF WORK TO BE UNDERTAKEN IN THE STUDY OF ALBERTA ROAD MATERIALS AND PROBLEMS ARISING FROM THEM

By Dr. K. A. Clark

The Problem Generally Stated

Alberta shares with all other provinces and similar organized communities in the pressing need of a serviceable system of rural highways for the efficient functioning of its productive efforts. But it also suffers from the unfortunate circumstance that nature has not placed among its natural resources a liberal distribution of the materials ordinarily used in the construction of durable roads. The population and the productiveness of the province has not reached the point where roads at any cost can be afforded. Material for the construction of the well-known types of hard surfaces cannot be transported from distances and a road constructed at a cost that is economically sound. The province is thus reduced to the necessity of doing the best it can with the materials that nature has placed at its immediate disposal.

Since, generally speaking, the only material at hand throughout the settled part of the province is the natural soil, it seems inevitable that Alberta must depend on some form of earth road construction for the most of its rural highways. The problem, then, is to learn how to build the most serviceable earth road.

No great advance has so far been made in this type of construction. Much can be done from the engineering standpoint in building well drained road grades, and in maintaining the surface by such means as dragging. This is being done by the provincial highway department. A further advance has been made in the direction of improving the properties of the soil aggregate by the combining of soil types to get a resultant aggregate that will alleviate either a predominant clayey or sandy nature with its accompanying bad behaviour on a road surface. Much remains to be learned in further modifying the properties of soil aggregates by the introduction of comparatively small quantities of materials which will have to be transported from a distance, but not in such large quantities as to be too serious a factor in construction cost. Alberta has a good chance in this direction because of its possession of resources of bituminous material in the "tar sand" deposits, and from the production of petroleum products which seems about to commence.

It is in the direction of studying the materials which Alberta must use to build her roads that the Research Committee proposes to do its work. It is thus obvious that its activities will not infringe on, nor duplicate, the work undertaken by the highway engineering organization of the province. The committee's work will be to secure information about Alberta road materials and results in their manipulation, and to place such information and results in the hands of the engineers. The highway engineers have neither the time nor the facilities to secure such information for themselves, although its possession would greatly aid them in supplying the province with more serviceable roads.

Proposed Programme of Work

Field Work

It is of basic importance to ascertain just what are the materials that exist to be used in road construction. The soil variations should be mapped out, and their properties from the road construction standpoint determined. Also all occurrences of sand and gravel should

be mapped and characterized. This work can be done very nicely as a special phase of the general task of working out the surface geology of the province. Geology is the logical basis of field work, whether in the interests of road materials, soil survey for agricultural purposes, or in taking stock of the province's clay resources for ceramic industries. A geological map, with accompanying data, will provide a complete inventory of the possessions of the province in the way of road materials. Our field work on road materials will take the form of co-operation in the compiling of a surface geology map with special attention from the standpoint of the highway construction problem.

Laboratory Work

Laboratory work will be required to be carried out paralleling field work, and will be to the end of securing the necessary data to supplement the field observations.

Laboratory work will also be prosecuted in the direction of studying the properties of soil types met throughout the province, to see if feasible combinations of materials occurring in the various localities can be made, and also to find out other modifications that may be possible and would cause the soil to take on more serviceable properties as road materials.

Tar Sands

The "tar sands" deposit is essentially a deposit of road material since it is in road construction that it is most likely to find an economic use. It consequently falls to the lot of the road materials branch of the Research Committee's work to investigate this deposit. So much public notice has been taken of the "tar sands" that it is high time that the question be cleared up.

There seem to be two main ways of reclaiming the bitumen from the sands. One is to drive it off by heat in a distillation retort. The other is to separate the bitumen from the sand by some means other than distillation, and to obtain it unchanged before proceeding to refine it for economic uses.

The work proposed in studying the "tar sands" problem can be summarized as follows:—

1. A study of the bituminous product obtained by the distillation of the crude sand to see to what extent the decomposition of the material due to the high temperatures employed has injured it for uses to which it might be put. The "cracking" accompanying the distillation process is a factor threatening the usefulness of this method, over and above the obvious objection of having to heat and handle in retorts so much useless sand.

2. The completion of the study of a method now under investigation, and showing promising possibilities, of separating the bitumen unchanged from the sand.

3. Determination of the economic uses that can be made of the products from the bituminous content of the "tar sand," especially of the portion suitable for road construction work.

4. Ways of combining the bitumen with natural soils so as to make a soil aggregate that will be impervious to water, and a serviceable medium for resisting the action of traffic.

5. Examination of the sand which will be separated from the bitumen in treating the "tar sand" for possible usefulness in glass manufacture.

The bitumen contained in the "tar sands" does not differ materially from the bitumen obtained by the refining of petroleum. If results are obtained in the use of "tar sand" bitumen in soil aggregates for road construction, such results will also apply for use in bitumen that may become available for Alberta by the development of an oil industry.